Appendix 11c-L

March 17, 1998 Updates to the 9% SIP
Houston/Galveston Ozone Nonattainment Area
On-Road Mobile Source Emissions Inventories
and Individual Control Program Reductions

March 17, 1998 Updates to the 9% SIP
Houston-Galveston Ozone Nonattainment Area
On-road Mobile Source Emissions Inventories and Individual Control Program Reductions

This section summarizes the procedures used for the March 17, 1998 updates to the on-road mobile source inventories and control strategy reductions for the Houston-Galveston Ozone Nonattainment Area(HGA). The June 1996 9% SIP submission did not include an estimation of emissions or emission reductions due to on-road mobile source controls for NOx. The EPA comments on the June 1996 9% SIP required TNRCC to include estimates for NOx and NOx reductions. This provided TNRCC with the opportunity to update the on-road mobile source inventories to reflect the latest information available for inputs in the MOBILE5A_H and the Travel Demand Model while expanding the inventories to include the calculation of NOx emissions.

The development of the updated inventories was done by HGAC at the request and under the direction of TNRCC. Updates to the on-road mobile source emission inventories and reduction estimates reflect changes made to HGA transportation network since the June 1996 SIP inventory development. The inventory development has been expanded to include the calculation of NOx emissions and the impact of the control strategies on NOx emissions. The methodologies used to calculate NOx emissions estimates is the same as the method used to calculate VOC emissions estimates. Control strategy emission reduction estimates include effects of the federal Tier 1 exhaust emissions standards, the Texas motor vehicle inspection and maintenance program and the reformulated gasoline program. Emission inventory updates and individual control program reduction estimates are summarized in Table 1. For full documentation on the final inventory numbers and the changes made to the inputs since the previous SIP submittal, please refer to the enclosed final report, Revised Rate-of-Progress State Implementation Plan On-road Mobile Source Emissions Inventories: 1999 Current Control, 1999 Control Strategy, For the Houston Galveston Ozone Nonattainment Area. To review the MOBILE5A_H model input or output files please refer to the enclosed diskette containing two files. Both files were compressed using the PKZIP utility.

Table 1

Summary of March 17, Updates to 9% SIP Inventories and Individual Control Program Reductions Houston-Galveston Ozone Nonattainment Area				
Inventory/Control Program Description	VOC Emissions (tons per ozone season day)	VOC Emission Reductions (tons per ozone season day)	NOx Emissions (tons per ozone season day)	NOx Emission Reductions (tons per ozone season day)
Current Control Emissions Inventory (Pre-1990 controls)	192.54		319.50	
Tier 1		7.71		23.82
Texas Motorist Choice I/M		25.42		11.67
Reformulated Gasoline		26.23		-3.09
Control Strategy Emissions Inventory (Pre-1990 and Post-1990 controls)	133.19		283.01	
Total Tier 1, I/M and RFG Benefit 1990 to 1999		59.36		32.40

The negative benefit for NOx due to the use of reformulated gasoline is the effect of an error in the MOBILE5A_H model. The federal rule for RFG requires that there be no increase in NOx emissions due to using RFG.

REVISED RATE-OF-PROGRESS STATE IMPLEMENTATION PLAN ON-ROAD MOBILE SOURCE EMISSIONS INVENTORIES:

1999 CURRENT CONTROL 1999 CONTROL STRATEGY

FOR THE HOUSTON-GALVESTON OZONE NONATTAINMENT AREA

March, 1998

HOUSTON-GALVESTON AREA COUNCIL

REVISED RATE-OF-PROGRESS STATE IMPLEMENTATION PLAN ON-ROAD MOBILE SOURCE *EMISSIONS INVENTORIES:*

1999 CURRENT CONTROL 1999 CONTROL STRATEGY

FOR THE HOUSTON-GALVESTON OZONE NONATTAINMENT AREA

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Revised State Implementation Plan Mobile Source Emissions Inventory Submittals For the Houston-Galveston Ozone Nonattainment Area:

9 Percent Rate-of-Progress Current Control and Control Strategy Inventories for 1999

Summary

This report presents the results of the analysis for the mobile source portion of the Houston-Galveston 9 % State Implementation Plan for 1999. The analysis has been updated since the previous 9 % SIP revision (June, 1996) to provide estimates of nitrogen oxide (NOx) emissions and to incorporate the most current travel demand estimates. The analysis was undertaken by the Houston-Galveston Area Council at the request of the Texas Natural Resource Conservation Commission.

The results of the analyses are shown in the tables below. Table 1 includes the county-level breakdown of volatile organic compound (VOC) and NOx emissions for the current control (i.e., pre-Clean Air Act Amendments of 1990) and control strategy (i.e., including Tier 1, inspections/maintenance [I/M], and reformulated gasoline [RFG] controls) scenarios. Table 2 indicates the relative contribution of each of the mandated controls to the emissions reductions achieved in the control strategy scenario.

Table 1
1999 ROP SIP Mobile Source Emission Inventories
Houston-Galveston Nonattainment Area
Volatile Organic Compounds and Nitrogen Oxides, TPOD

	VOC		NOx	
County	Control Strategy	Current Control	Control Strategy	Current Control
HARRIS	94.55	143.23	194.85	223.37
BRAZORIA	6.51	8.36	13.12	14.45
FORT BEND	9.06	11.64	18.35	20.18
WALLER	1.88	2.34	6.07	6.47
MONTGOMERY	9.22	11.80	20.98	23.04
LIBERTY	2.45	3.08	6.74	7.21
CHAMBERS	3.32	4.11	11.50	12.24
GALVESTON	6.20	7.97	11.40	12.54
Totals:	133.19	192.54	283.01	319.50

Source: Houston-Galveston Area Council, March, 1998.

Background

The Clean Air Act Amendments (CAAA) of 1990 require Rate-of-Progress (ROP) SIPs for ozone nonattainment areas to demonstrate progress towards the reduction of ozone-forming percursors. The TNRCC previously submitted a 9 % ROP SIP for the Houston Galveston region to the Environmental Protection Agency in June of 1996, including mobile source VOC inventories. However, EPA has proposed to disapprove the SIP revision, as EPA believes that some of the reductions claimed under the point (i.e. industrial) source category are non-creditable.

Table 2
1999 ROP SIP Mobile Source Control Strategy Benefits
Houston-Galveston Nonattainment Area
Volatile Organic Compounds and Nitrogen Oxides, TPOD

	VOC	NOx[1]
Tier 1	7.71	23.82
I/M	25.42	11.67
RFG	26.23	-3.09
Total Prog. Reductions	**59.36**	**32.40**

Source: Houston-Galveston Area Council, March, 1998.

In order to avoid potential sanctions as a result of the expected SIP disapproval, the TNRCC agreed to revise the 9 % SIP for the Houston region so as to include NOx estimates[2]. To develop the mobile source portion of the SIP, TNRCC requested the assistance of H-GAC, which as the regional metropolitan planning organization (MPO) develops estimates of regional vehicle miles of travel and vehicular speeds.

This report presents the results of the inventory analyses for the current control and control strategy scenarios, as well as the effects of each of the mandated control programs. The current control (CC) scenario reflects the hypothetical situation where only the controls (e.g., Federal Motor Vehicle Control Program) implemented prior to the passage of the CAAA are in effect. The control strategy (CS) scenario reflects all current expected controls, including the Tier 1, inspections/maintenance (I/M), and reformulated gasoline (RFG).

Methodology: Modifications to Previous Procedures

The methodology used to obtain the estimates provided in this report is essentially unchanged from the VMT Offset SIP report, submitted to the TNRCC in June, 1997, which incorporated much of the approach used in the development of the previous 9% SIP mobile source analysis, submitted in June, 1996 to TNRCC. The VMT Offset SIP methodology is provided in Appendix A. Where there have been significant changes in procedure or inputs since either of the aforementioned SIP revisions, discussion is provided below. Otherwise, it may be assumed that the procedures used were the same.

[1] The apparent disbenefit in NOx emissions from the use of reformulated gasoline appears to be the result of an error in MOBILE5a_H, based on conversations with the TNRCC. A preliminary evaluation using a later version of the model (MOBILE5b) yielded a 0.2 percent decrease in NOx emissions as a result of the use of RFG, holding all other parameters constant. The true control strategy value for NOx emissions is probably less than indicated in Table 1.

[2] ROP SIP guidance permits the use of both VOC and NOx reductions in determining progress. Previously, however, the TNRCC had needed to estimate only VOC reductions, as EPA had granted the state a temporarty NOx "waiver" based on preliminary urban airshed modeling.

TABLE 3
1999 NETWORK VEHICLE MILES OF TRAVEL (VMT) AND 24 HOUR SPEEDS
FROM A SUMMED TIME-OF-DAY ANALYSIS
FOR THE HOUSTON-GALVESTON OZONE NONATTAINMENT AREA

ROAD TYPE		HARRIS	BRAZORIA	FORT BEND	WALLER	MONTGMRY	LIBERTY	CHAMBERS	GALVESTON	TOTALS
FREEWAYS	VMT	41,553,630	1,094,595	2,489,444	822,989	3,295,291	286,038	1,998,004	1,246,642	52,786,633
	SPEED	56.6	72.67	67.98	73.29	71.66	75.59	75.56	72.66	59.87
PRINCIPAL	VMT	11,868,780	1,239,526	1,204,267	133,261	142,857	533,181	44,899	1,144,802	16,311,574
ARTERIALS	SPEED	33.69	52.55	58.38	62.23	72.14	51.68	48.6	52.57	39.47
OTHER	VMT	22,169,444	1,266,125	1,557,967	27,090	1,234,097	350,136	106,674	1,574,498	28,306,030
ARTERIALS	SPEED	28.74	44.6	40.91	52.4	50.4	52.6	51.57	37.97	32
MAJOR	VMT	970,758	901,534	714,373	306,592	1,425,268	369,731	275,949	64,977	5,029,181
COLLECTORS	SPEED	46.25	49.41	46.69	55.57	51.83	57.35	54.82	38.74	50.22
OTHER	VMT	935,683	156,844	350,875	46,893	575,858	141,037	25,363	114,718	2,347,271
COLLECTORS	SPEED	30.54	49.9	47.67	49.37	46.22	52.11	50.61	40.91	41.13
LOCALS	VMT	8,361,157	752,637	1,069,756	150,091	1,130,554	310,684	124,007	633,652	12,532,538
	SPEED	21.98	30.68	29.93	35.47	34.7	36.03	33.65	25.05	25.11
TOTALS	VMT	85,859,452	5,431,261	7,386,682	1,486,916	7,803,925	1,990,807	2,574,896	4,779,289	117,313,228
	SPEED	42.47	51.09	52.17	63.69	57.6	53.92	69.61	48.88	45.81

Note: Totals may not sum due to rounding errors.
Source: H-GAC, October, 1997.

Travel Demand Model

H-GAC has not changed its modeling procedures since the adoption of the VMT Offset SIP. H-GAC has updated its roadway modeling networks to account for the latest known information about expected project completions by 1999, however.[3] In addition, staff obtained more current mode-split information from the Harris County Metropolitan Transit Authority[4]. Thus, while the process remains essentially unchanged since the VMT Offset SIP report submission, the estimates of vehicle miles traveled and speeds are somewhat different. See Table 3 above.

Emission Rate Development

The emission rates are the same as those developed for the previous 9 percent SIP revision, in June 1996, with some minor corrections. Rates for the a.m. peak and 24-hour scenarios were remodeled to correct for errors resulting from the use of incorrect data in the 1996 SIP revision. All EPA emissions rate MOBILE5a_H model inputs and outputs are contained in the attached 3-inch diskettes.

Emissions Modeling

The emissions modeling process was essentially the same as that for either of the two previous SIP revisions. However, the current effort was conducted entirely on local networks, using Texas Transportation Institute software written for the MicroSoft DOS personal computer environment.[5] The input data and FORTRAN programs were analogous to those used on the Texas A&M mainframe computer and discussed in the SuperSIP text.

NOx Analysis and Post-Modeling Calculations

The current results differ from those of the previous two efforts in that NOx estimates are presented. While NOx levels have always been an output from the EPA and TTI emissions models, H-GAC has not had to present summarized NOx emissions estimates for previous ROP or VMT Offset SIP analyses. To address the current requirements, H-GAC approached the summarization of NOx estimates in the same manner as for VOC. That is, totals were obtained from the travel demand analyses; adjustments were made to account for transit emissions and nonrecurring congestion in Harris County; and adjustments were then made for all counties to provide November 15 evaluation date estimates[6].

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[3] For information about the travel demand model network used in this analysis, see H-GAC document *Vision 2020: The Metropolitan Transportation Plan*, Appendix E, Revised December, 1997. For information about the network used in support of the VMT Offset SIP work, see H-GAC document and appendices entitled *Conformity Determination for the 1996 Transportation Improvement Program and the Plan Update to* Access 2010 – The Metropolitan Transportation Plan *for the Houston-Galveston Transportation Management Area*, November 17, 1995.

[4] For the *V2020* conformity analysis, the estimated percentage of person trips on transit was 3.97 percent. For the analysis in support of the VMT Offset SIP, the estimated percentage of person trips on transit was 4.55 percent.

[5] See *Texas Mobile Source Emissions Software Version 2.0: User's Guide (Draft)*, Texas Transportation Institute, Research Report 1279-9, February 1995, for an explanation of the emissions modeling programs.

[6] The methodology to determine the emissions effects of nonrecurring congestion is based on the change in average speeds. Because NOx emissions increase with speeds above 20 miles per hour (whereas VOC emissions decrease), this methodology would yield results that would indicate that freeway NOx emissions would decrease as a result of the decrease in average speeds associated with nonrecurring congestion. Since such an outcome seems counterintuitive, NOx levels on Harris County freeways are not ultimately adjusted for the effects of nonrecurring congestion.

The November 15 adjustment factor inputs for VOC emissions have been corrected to reflect the appropriate vehicular turnover rate between the model years 1999 and 2000. As in the past, the adjustment was undertaken to estimate vehicular emissions on the anniversary date of the Clean Air Act Amendments of 1990, to approximate the beneficial emissions effects of fleet turnover from July 1 to November 15. For the 1999 evaluation year, the procedure involves an interpolation between the July 1 estimates produced by the MOBILE5a_H model for the years 1999 and 2000. However, during the SuperSIP and VMT Offset SIP support work, incorrect emission rates were used for the year 2000. This error resulted in excessive credit given to fleet turnover, yielding emissions levels that were too low.

Results

Tables 4 through 7 below present the results of the 9% SIP mobile source emissions inventory analysis for VOC and NOx, for both the control strategy and current control scenarios. The results are broken down by county, facility type, and vehicle type.

Table 4
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Control Strategy Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
VOC, tons per ozone day

Harris County									
ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	25.1150	7.6873	4.0946	1.4028	0.0330	0.0189	1.5324	0.5260	40.4099
PRINCIPAL ARTERIALS	8.3135	2.4421	1.2784	0.5256	0.0129	0.0073	0.3635	0.1386	13.0819
OTHER ARTERIALS	17.1630	4.9951	2.6114	1.0947	0.0270	0.0153	0.7241	0.2680	26.8985
MAJOR COLLECTORS	0.5350	0.1614	0.0848	0.0333	0.0009	0.0005	0.0548	0.0103	0.8810
OTHER COLLECTORS	0.7002	0.2043	0.1068	0.0450	0.0011	0.0006	0.0628	0.0110	1.1317
LOCALS	7.7630	2.2303	1.1647	0.5119	0.0124	0.0070	0.3513	0.1094	12.1501
TOTALS	59.5898	17.7204	9.3407	3.6133	0.0873	0.0495	3.0889	1.0634	94.5531
Brazoria County									
ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.8212	0.2621	0.1395	0.0398	0.0007	0.0004	0.0353	0.0144	1.3134
PRINCIPAL ARTERIALS	0.8660	0.2673	0.1386	0.0557	0.0011	0.0006	0.0283	0.0139	1.3714
OTHER ARTERIALS	1.0274	0.3164	0.1652	0.0632	0.0011	0.0007	0.0320	0.0155	1.6214
MAJOR COLLECTORS	0.5816	0.1827	0.0951	0.0365	0.0006	0.0004	0.0179	0.0102	0.9249
OTHER COLLECTORS	0.1166	0.0357	0.0186	0.0076	0.0001	0.0000	0.0039	0.0018	0.1842
LOCALS	0.6956	0.2089	0.1082	0.0464	0.0008	0.0005	0.0238	0.0093	1.0935
TOTALS	4.1086	1.2731	0.6650	0.2492	0.0043	0.0025	0.1411	0.0651	6.5089
Fort Bend County									
ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.8727	0.5947	0.3151	0.0978	0.0018	0.0011	0.0850	0.0334	3.0016
PRINCIPAL ARTERIALS	0.8476	0.2608	0.1350	0.0550	0.0011	0.0006	0.0278	0.0134	1.3413
OTHER ARTERIALS	1.2506	0.3826	0.1992	0.0786	0.0015	0.0009	0.0405	0.0184	1.9721
MAJOR COLLECTORS	0.4576	0.1438	0.0748	0.0286	0.0005	0.0004	0.0139	0.0080	0.7275
OTHER COLLECTORS	0.2717	0.0830	0.0429	0.0177	0.0004	0.0002	0.0091	0.0040	0.4290
LOCALS	1.0136	0.3033	0.1572	0.0674	0.0013	0.0007	0.0350	0.0132	1.5917
TOTALS	5.7139	1.7683	0.9241	0.3450	0.0065	0.0038	0.2114	0.0903	9.0633
Waller County									
ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.6090	0.2420	0.1079	0.0112	0.0005	0.0004	0.0889	0.0107	1.0705
PRINCIPAL ARTERIALS	0.0935	0.0264	0.0270	0.0082	0.0000	0.0000	0.0090	0.0016	0.1656
OTHER ARTERIALS	0.0179	0.0050	0.0051	0.0017	0.0000	0.0000	0.0020	0.0003	0.0319
MAJOR COLLECTORS	0.1954	0.0544	0.0556	0.0188	0.0002	0.0000	0.0208	0.0033	0.3486
OTHER COLLECTORS	0.0289	0.0081	0.0082	0.0030	0.0000	0.0000	0.0034	0.0005	0.0520
LOCALS	0.1160	0.0312	0.0317	0.0120	0.0000	0.0000	0.0141	0.0017	0.2067
TOTALS	1.0606	0.3671	0.2355	0.0548	0.0007	0.0004	0.1382	0.0180	1.8753

Table 4, cont.
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Control Strategy Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
VOC, tons per ozone day

Montgomery County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	2.4921	0.7941	0.4217	0.1278	0.0023	0.0013	0.1103	0.0445	3.9940
PRINCIPAL ARTERIALS	0.1123	0.0341	0.0177	0.0072	0.0001	0.0000	0.0038	0.0018	0.1769
OTHER ARTERIALS	0.8751	0.2736	0.1430	0.0530	0.0010	0.0005	0.0263	0.0144	1.3868
MAJOR COLLECTORS	0.9426	0.2952	0.1537	0.0583	0.0011	0.0006	0.0290	0.0158	1.4962
OTHER COLLECTORS	0.4148	0.1275	0.0660	0.0271	0.0005	0.0004	0.0137	0.0064	0.6563
LOCALS	0.9608	0.2902	0.1504	0.0629	0.0012	0.0007	0.0327	0.0135	1.5124
TOTALS	5.7977	1.8147	0.9524	0.3362	0.0061	0.0034	0.2157	0.0964	9.2226

Liberty County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.2158	0.0859	0.0383	0.0039	0.0001	0.0001	0.0308	0.0037	0.3787
PRINCIPAL ARTERIALS	0.3687	0.1021	0.1042	0.0355	0.0005	0.0001	0.0402	0.0059	0.6571
OTHER ARTERIALS	0.2295	0.0639	0.0651	0.0221	0.0003	0.0000	0.0252	0.0038	0.4098
MAJOR COLLECTORS	0.2383	0.0667	0.0681	0.0224	0.0003	0.0000	0.0247	0.0041	0.4247
OTHER COLLECTORS	0.0884	0.0246	0.0249	0.0089	0.0000	0.0000	0.0100	0.0016	0.1584
LOCALS	0.2379	0.0643	0.0654	0.0247	0.0003	0.0000	0.0290	0.0036	0.4252
TOTALS	1.3786	0.4076	0.3659	0.1175	0.0015	0.0002	0.1599	0.0227	2.4539

Chambers County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.5009	0.5967	0.2667	0.0269	0.0012	0.0009	0.2159	0.0263	2.6355
PRINCIPAL ARTERIALS	0.0277	0.0077	0.0077	0.0029	0.0000	0.0000	0.0032	0.0006	0.0498
OTHER ARTERIALS	0.0664	0.0186	0.0188	0.0067	0.0000	0.0000	0.0075	0.0012	0.1191
MAJOR COLLECTORS	0.1729	0.0482	0.0491	0.0168	0.0001	0.0000	0.0188	0.0030	0.3089
OTHER COLLECTORS	0.0152	0.0042	0.0044	0.0016	0.0000	0.0000	0.0018	0.0003	0.0275
LOCALS	0.0983	0.0265	0.0270	0.0101	0.0000	0.0000	0.0120	0.0014	0.1752
TOTALS	1.8815	0.7019	0.3736	0.0649	0.0013	0.0009	0.2593	0.0327	3.3160

Galveston County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.9515	0.3037	0.1618	0.0477	0.0009	0.0005	0.0408	0.0168	1.5238
PRINCIPAL ARTERIALS	0.8979	0.2740	0.1421	0.0579	0.0011	0.0006	0.0297	0.0133	1.4164
OTHER ARTERIALS	1.2667	0.3860	0.2000	0.0825	0.0016	0.0010	0.0422	0.0186	1.9985
MAJOR COLLECTORS	0.0410	0.0129	0.0068	0.0026	0.0000	0.0000	0.0012	0.0008	0.0653
OTHER COLLECTORS	0.0936	0.0284	0.0147	0.0062	0.0000	0.0000	0.0031	0.0012	0.1472
LOCALS	0.6659	0.1981	0.1025	0.0450	0.0008	0.0005	0.0231	0.0083	1.0441
TOTALS	3.9167	1.2032	0.6278	0.2418	0.0043	0.0025	0.1400	0.0589	6.1952

Regional Total

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	33.5783	10.5665	5.5456	1.7580	0.0403	0.0234	2.1394	0.6758	54.3274
PRINCIPAL ARTERIALS	11.5272	3.4146	1.8505	0.7479	0.0167	0.0091	0.5053	0.1890	18.2604
OTHER ARTERIALS	21.8967	6.4411	3.4076	1.4024	0.0324	0.0183	0.8997	0.3402	34.4384
MAJOR COLLECTORS	3.1644	0.9655	0.5880	0.2172	0.0036	0.0018	0.1811	0.0556	5.1771
OTHER COLLECTORS	1.7295	0.5157	0.2863	0.1169	0.0021	0.0012	0.1078	0.0267	2.7862
LOCALS	11.5512	3.3528	1.8070	0.7804	0.0167	0.0093	0.5211	0.1603	18.1988
TOTALS	83.4473	25.2562	13.4851	5.0227	0.1119	0.0632	4.3544	1.4475	133.1882

Table 5
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Current Control Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
VOC, tons per ozone day

Harris County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	38.9942	11.6047	6.0657	1.7918	0.0329	0.0189	1.5343	0.5903	60.6329
PRINCIPAL ARTERIALS	13.0709	3.7198	1.9111	0.6752	0.0129	0.0073	0.3629	0.1565	19.9166
OTHER ARTERIALS	27.0741	7.6266	3.9111	1.4041	0.0270	0.0153	0.7235	0.3017	41.0835
MAJOR COLLECTORS	0.8336	0.2444	0.1261	0.0429	0.0009	0.0005	0.0542	0.0117	1.3144
OTHER COLLECTORS	1.1048	0.3120	0.1600	0.0577	0.0011	0.0006	0.0623	0.0123	1.7108
LOCALS	12.2789	3.4155	1.7478	0.6519	0.0124	0.0070	0.3403	0.1228	18.5767
TOTALS	93.3566	26.9230	13.9219	4.6236	0.0873	0.0495	3.0775	1.1953	143.2349

Brazoria County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.0563	0.3334	0.1721	0.0474	0.0007	0.0004	0.0353	0.0159	1.6616
PRINCIPAL ARTERIALS	1.1346	0.3460	0.1741	0.0667	0.0011	0.0006	0.0283	0.0157	1.7670
OTHER ARTERIALS	1.3467	0.4091	0.2072	0.0752	0.0011	0.0007	0.0320	0.0175	2.0894
MAJOR COLLECTORS	0.7580	0.2356	0.1191	0.0437	0.0006	0.0004	0.0179	0.0114	1.1867
OTHER COLLECTORS	0.1532	0.0464	0.0233	0.0090	0.0001	0.0000	0.0039	0.0019	0.2378
LOCALS	0.9216	0.2722	0.1368	0.0549	0.0008	0.0005	0.0238	0.0105	1.4210
TOTALS	5.3704	1.6427	0.8327	0.2969	0.0043	0.0025	0.1411	0.0729	8.3635

Fort Bend County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	2.4148	0.7580	0.3898	0.1166	0.0018	0.0011	0.0850	0.0371	3.8041
PRINCIPAL ARTERIALS	1.1116	0.3377	0.1699	0.0657	0.0011	0.0006	0.0278	0.0152	1.7295
OTHER ARTERIALS	1.6446	0.4959	0.2506	0.0936	0.0015	0.0009	0.0405	0.0207	2.5482
MAJOR COLLECTORS	0.5960	0.1854	0.0937	0.0342	0.0005	0.0004	0.0139	0.0089	0.9330
OTHER COLLECTORS	0.3575	0.1077	0.0540	0.0212	0.0004	0.0002	0.0091	0.0044	0.5545
LOCALS	1.3432	0.3954	0.1988	0.0796	0.0013	0.0007	0.0350	0.0148	2.0688
TOTALS	7.4676	2.2801	1.1569	0.4108	0.0065	0.0038	0.2114	0.1011	11.6383

Waller County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.7763	0.2988	0.1335	0.0130	0.0005	0.0004	0.0889	0.0119	1.3233
PRINCIPAL ARTERIALS	0.1200	0.0335	0.0337	0.0096	0.0000	0.0000	0.0090	0.0018	0.2075
OTHER ARTERIALS	0.0232	0.0064	0.0064	0.0021	0.0000	0.0000	0.0020	0.0003	0.0403
MAJOR COLLECTORS	0.2513	0.0694	0.0695	0.0220	0.0002	0.0000	0.0208	0.0037	0.4369
OTHER COLLECTORS	0.0374	0.0103	0.0102	0.0035	0.0000	0.0000	0.0034	0.0005	0.0654
LOCALS	0.1515	0.0403	0.0402	0.0140	0.0000	0.0000	0.0141	0.0018	0.2618
TOTALS	1.3598	0.4586	0.2934	0.0641	0.0007	0.0004	0.1382	0.0200	2.3351

Table 5, cont.
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Current Control Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
VOC, tons per ozone day

Montgomery County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	3.2076	1.0107	0.5211	0.1522	0.0023	0.0013	0.1103	0.0497	5.0550
PRINCIPAL ARTERIALS	0.1475	0.0442	0.0222	0.0087	0.0001	0.0000	0.0038	0.0019	0.2283
OTHER ARTERIALS	1.1428	0.3527	0.1792	0.0635	0.0010	0.0005	0.0263	0.0162	1.7821
MAJOR COLLECTORS	1.2292	0.3809	0.1925	0.0698	0.0011	0.0006	0.0290	0.0179	1.9210
OTHER COLLECTORS	0.5446	0.1654	0.0833	0.0322	0.0005	0.0004	0.0137	0.0072	0.8472
LOCALS	1.2713	0.3777	0.1900	0.0749	0.0012	0.0007	0.0327	0.0151	1.9636
TOTALS	7.5430	2.3316	1.1883	0.4013	0.0061	0.0034	0.2157	0.1080	11.7973

Liberty County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.2751	0.1059	0.0474	0.0046	0.0001	0.0001	0.0308	0.0043	0.4683
PRINCIPAL ARTERIALS	0.4761	0.1306	0.1308	0.0416	0.0005	0.0001	0.0402	0.0068	0.8267
OTHER ARTERIALS	0.2961	0.0815	0.0816	0.0260	0.0003	0.0000	0.0252	0.0044	0.5151
MAJOR COLLECTORS	0.3060	0.0849	0.0851	0.0263	0.0003	0.0000	0.0247	0.0046	0.5319
OTHER COLLECTORS	0.1143	0.0315	0.0315	0.0104	0.0000	0.0000	0.0100	0.0017	0.1993
LOCALS	0.3109	0.0829	0.0827	0.0290	0.0003	0.0000	0.0290	0.0039	0.5387
TOTALS	1.7784	0.5173	0.4592	0.1378	0.0015	0.0002	0.1599	0.0257	3.0800

Chambers County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.9122	0.7362	0.3298	0.0315	0.0012	0.0009	0.2159	0.0293	3.2571
PRINCIPAL ARTERIALS	0.0358	0.0098	0.0098	0.0033	0.0000	0.0000	0.0032	0.0006	0.0626
OTHER ARTERIALS	0.0858	0.0236	0.0236	0.0078	0.0000	0.0000	0.0075	0.0013	0.1497
MAJOR COLLECTORS	0.2226	0.0616	0.0616	0.0197	0.0001	0.0000	0.0188	0.0033	0.3878
OTHER COLLECTORS	0.0198	0.0055	0.0055	0.0019	0.0000	0.0000	0.0018	0.0003	0.0346
LOCALS	0.1285	0.0341	0.0340	0.0118	0.0000	0.0000	0.0120	0.0016	0.2220
TOTALS	2.4047	0.8708	0.4644	0.0761	0.0013	0.0009	0.2593	0.0364	4.1138

Galveston County

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.2233	0.3862	0.1997	0.0568	0.0009	0.0005	0.0408	0.0187	1.9268
PRINCIPAL ARTERIALS	1.1786	0.3549	0.1787	0.0688	0.0011	0.0006	0.0297	0.0151	1.8275
OTHER ARTERIALS	1.6696	0.5012	0.2525	0.0981	0.0016	0.0010	0.0422	0.0209	2.5871
MAJOR COLLECTORS	0.0532	0.0167	0.0083	0.0030	0.0000	0.0000	0.0012	0.0009	0.0833
OTHER COLLECTORS	0.1235	0.0368	0.0186	0.0073	0.0000	0.0000	0.0031	0.0015	0.1907
LOCALS	0.8843	0.2585	0.1300	0.0527	0.0008	0.0005	0.0231	0.0092	1.3592
TOTALS	5.1325	1.5544	0.7878	0.2868	0.0043	0.0025	0.1400	0.0663	7.9747

Regional Total

ROADWAY TYPE	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	49.8598	15.2338	7.8592	2.2140	0.0403	0.0235	2.1413	0.7572	78.1291
PRINCIPAL ARTERIALS	17.2751	4.9765	2.6303	0.9396	0.0167	0.0091	0.5048	0.2136	26.5658
OTHER ARTERIALS	33.2829	9.4970	4.9124	1.7704	0.0324	0.0183	0.8992	0.3830	50.7955
MAJOR COLLECTORS	4.2499	1.2791	0.7560	0.2617	0.0036	0.0018	0.1805	0.0624	6.7951
OTHER COLLECTORS	2.4550	0.7156	0.3864	0.1432	0.0021	0.0012	0.1072	0.0298	3.8403
LOCALS	17.2903	4.8766	2.5604	0.9687	0.0167	0.0093	0.5101	0.1797	26.4119
TOTALS	124.4129	36.5785	19.1046	6.2975	0.1119	0.0632	4.3431	1.6257	192.5375

Table 6
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Control Strategy Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
NOx, tons per ozone day

HARRIS									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	59.9716	17.0908	9.2896	5.0387	0.1874	0.0852	20.0866	0.1501	111.8999
PRINCIPAL ARTERIALS	13.0676	3.6111	1.9482	1.3775	0.0382	0.0174	2.4038	0.0272	22.4909
OTHER ARTERIALS	23.9469	6.6342	3.5717	2.4755	0.0708	0.0321	4.2759	0.0478	41.0549
MAJOR COLLECTORS	1.1467	0.3180	0.1724	0.1216	0.0034	0.0016	0.4074	0.0026	2.1737
OTHER COLLECTORS	0.9954	0.2756	0.1486	0.1040	0.0030	0.0014	0.3834	0.0021	1.9135
LOCALS	8.7777	2.4512	1.3141	0.8812	0.0281	0.0128	1.8334	0.0159	15.3144
TOTAL	107.9059	30.3809	16.4447	9.9984	0.3309	0.1504	29.3904	0.2457	194.8473
BRAZORIA									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.9051	0.5737	0.3080	0.1415	0.0059	0.0028	0.6827	0.0046	3.6243
PRINCIPAL ARTERIALS	1.4796	0.4237	0.2264	0.1612	0.0040	0.0020	0.2613	0.0032	2.5614
OTHER ARTERIALS	1.7334	0.5068	0.2714	0.1686	0.0049	0.0023	0.3207	0.0037	3.0118
MAJOR COLLECTORS	1.2461	0.3628	0.1946	0.1256	0.0034	0.0016	0.2246	0.0028	2.1614
OTHER COLLECTORS	0.1852	0.0530	0.0283	0.0199	0.0005	0.0002	0.0324	0.0004	0.3200
LOCALS	0.8338	0.2393	0.1274	0.0880	0.0022	0.0012	0.1489	0.0016	1.4424
TOTAL	7.3831	2.1594	1.1561	0.7049	0.0209	0.0101	1.6706	0.0163	13.1213
FORT BEND									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	4.1833	1.2558	0.6737	0.3256	0.0127	0.0060	1.5482	0.0103	8.0156
PRINCIPAL ARTERIALS	1.4242	0.4076	0.2178	0.1552	0.0037	0.0018	0.2467	0.0031	2.4600
OTHER ARTERIALS	1.9441	0.5631	0.3011	0.1975	0.0054	0.0024	0.3505	0.0041	3.3682
MAJOR COLLECTORS	1.0089	0.2946	0.1581	0.1002	0.0027	0.0013	0.1820	0.0022	1.7500
OTHER COLLECTORS	0.4114	0.1179	0.0630	0.0441	0.0011	0.0005	0.0736	0.0009	0.7125
LOCALS	1.1800	0.3396	0.1807	0.1238	0.0032	0.0016	0.2117	0.0023	2.0428
TOTAL	10.1518	2.9786	1.5944	0.9463	0.0289	0.0135	2.6127	0.0229	18.3491
WALLER									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.3937	0.5132	0.2394	0.0360	0.0041	0.0024	1.7539	0.0030	3.9457
PRINCIPAL ARTERIALS	0.2086	0.0542	0.0585	0.0257	0.0005	0.0003	0.1492	0.0004	0.4973
OTHER ARTERIALS	0.0375	0.0096	0.0103	0.0050	0.0000	0.0000	0.0250	0.0000	0.0873
MAJOR COLLECTORS	0.4370	0.1124	0.1212	0.0575	0.0013	0.0005	0.2946	0.0008	1.0252
OTHER COLLECTORS	0.0573	0.0144	0.0156	0.0084	0.0001	0.0000	0.0382	0.0000	0.1340
LOCALS	0.1641	0.0410	0.0440	0.0244	0.0005	0.0001	0.1040	0.0003	0.3784
TOTAL	2.2983	0.7447	0.4889	0.1569	0.0065	0.0033	2.3650	0.0045	6.0680

Table 6, cont.
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Control Strategy Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
NOx, tons per ozone day

MONTGOMERY

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	5.6877	1.7116	0.9184	0.4359	0.0177	0.0082	2.1124	0.0139	10.9059
PRINCIPAL ARTERIALS	0.1687	0.0484	0.0258	0.0178	0.0005	0.0002	0.0295	0.0004	0.2913
OTHER ARTERIALS	1.7076	0.4984	0.2674	0.1690	0.0048	0.0023	0.3178	0.0037	2.9711
MAJOR COLLECTORS	1.9798	0.5776	0.3097	0.1971	0.0054	0.0025	0.3571	0.0043	3.4335
OTHER COLLECTORS	0.6924	0.1987	0.1063	0.0743	0.0019	0.0008	0.1224	0.0015	1.1982
LOCALS	1.2642	0.3617	0.1928	0.1352	0.0032	0.0016	0.2175	0.0026	2.1787
TOTAL	11.5004	3.3965	1.8204	1.0293	0.0335	0.0156	3.1567	0.0264	20.9787

LIBERTY

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.4922	0.1813	0.0847	0.0126	0.0016	0.0009	0.6266	0.0010	1.4007
PRINCIPAL ARTERIALS	0.7316	0.1876	0.2020	0.0971	0.0020	0.0008	0.4964	0.0014	1.7189
OTHER ARTERIALS	0.4784	0.1225	0.1320	0.0644	0.0013	0.0005	0.3224	0.0009	1.1223
MAJOR COLLECTORS	0.5457	0.1408	0.1518	0.0703	0.0015	0.0005	0.3697	0.0012	1.2813
OTHER COLLECTORS	0.1865	0.0474	0.0511	0.0259	0.0005	0.0002	0.1243	0.0004	0.4363
LOCALS	0.3397	0.0851	0.0913	0.0507	0.0009	0.0004	0.2163	0.0006	0.7850
TOTAL	2.7741	0.7647	0.7129	0.3210	0.0076	0.0032	2.1556	0.0055	6.7446

CHAMBERS

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	3.4338	1.2660	0.5908	0.0879	0.0103	0.0059	4.3701	0.0073	9.7721
PRINCIPAL ARTERIALS	0.0530	0.0132	0.0143	0.0080	0.0001	0.0000	0.0358	0.0000	0.1243
OTHER ARTERIALS	0.1356	0.0344	0.0370	0.0195	0.0004	0.0001	0.0919	0.0003	0.3191
MAJOR COLLECTORS	0.3846	0.0987	0.1062	0.0515	0.0011	0.0005	0.2581	0.0008	0.9015
OTHER COLLECTORS	0.0309	0.0077	0.0084	0.0046	0.0000	0.0000	0.0209	0.0000	0.0724
LOCALS	0.1351	0.0339	0.0363	0.0198	0.0003	0.0000	0.0850	0.0003	0.3108
TOTAL	4.1729	1.4539	0.7930	0.1913	0.0121	0.0065	4.8617	0.0087	11.5002

GALVESTON

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	2.2109	0.6673	0.3582	0.1675	0.0069	0.0031	0.8050	0.0054	4.2242
PRINCIPAL ARTERIALS	1.3707	0.3947	0.2110	0.1446	0.0038	0.0018	0.2455	0.0029	2.3750
OTHER ARTERIALS	1.8521	0.5321	0.2841	0.1960	0.0050	0.0024	0.3290	0.0038	3.2045
MAJOR COLLECTORS	0.0958	0.0281	0.0152	0.0093	0.0003	0.0000	0.0174	0.0002	0.1663
OTHER COLLECTORS	0.1308	0.0374	0.0200	0.0141	0.0004	0.0001	0.0229	0.0003	0.2258
LOCALS	0.6911	0.1997	0.1064	0.0705	0.0021	0.0009	0.1287	0.0013	1.2006
TOTAL	6.3514	1.8592	0.9948	0.6019	0.0184	0.0083	1.5486	0.0139	11.3965

Regional Totals

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	79.2782	23.2596	12.4628	6.2456	0.2465	0.1145	31.9856	0.1956	153.7884
PRINCIPAL ARTERIALS	18.5039	5.1405	2.9040	1.9870	0.0528	0.0241	3.8682	0.0386	32.5191
OTHER ARTERIALS	31.8356	8.9011	4.8749	3.2955	0.0925	0.0423	6.0332	0.0643	55.1393
MAJOR COLLECTORS	6.8446	1.9330	1.2292	0.7330	0.0191	0.0084	2.1109	0.0149	12.8929
OTHER COLLECTORS	2.6899	0.7522	0.4412	0.2952	0.0074	0.0031	0.8180	0.0056	5.0127
LOCALS	13.3857	3.7515	2.0931	1.3936	0.0405	0.0185	2.9455	0.0249	23.6532
TOTALS	152.5378	43.7378	24.0052	13.9498	0.4587	0.2109	47.7614	0.3439	283.0056

Table 7
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Current Control Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
NOx, tons per ozone day

HARRIS									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	70.7189	20.5355	10.2206	5.3891	0.1873	0.0852	20.5052	0.1501	127.7919
PRINCIPAL ARTERIALS	15.4447	4.3508	2.1455	1.4692	0.0382	0.0174	2.4519	0.0271	25.9448
OTHER ARTERIALS	28.3047	7.9991	3.9344	2.6403	0.0708	0.0321	4.3675	0.0478	47.3967
MAJOR COLLECTORS	1.3547	0.3825	0.1898	0.1295	0.0034	0.0016	0.4091	0.0026	2.4731
OTHER COLLECTORS	1.1767	0.3324	0.1636	0.1108	0.0030	0.0014	0.3846	0.0021	2.1745
LOCALS	10.3694	2.9589	1.4479	0.9407	0.0281	0.0128	1.8129	0.0159	17.5867
TOTAL	127.3690	36.5592	18.1017	10.6796	0.3308	0.1504	29.9313	0.2456	223.3677
BRAZORIA									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	2.1359	0.6542	0.3210	0.1484	0.0059	0.0028	0.6934	0.0046	3.9662
PRINCIPAL ARTERIALS	1.6649	0.4840	0.2361	0.1690	0.0040	0.0020	0.2653	0.0032	2.8284
OTHER ARTERIALS	1.9475	0.5787	0.2831	0.1768	0.0049	0.0023	0.3257	0.0037	3.3227
MAJOR COLLECTORS	1.3999	0.4141	0.2029	0.1315	0.0034	0.0016	0.2282	0.0028	2.3844
OTHER COLLECTORS	0.2084	0.0606	0.0296	0.0208	0.0005	0.0002	0.0329	0.0004	0.3534
LOCALS	0.9384	0.2739	0.1330	0.0925	0.0022	0.0012	0.1512	0.0016	1.5940
TOTAL	8.2951	2.4655	1.2056	0.7391	0.0209	0.0101	1.6967	0.0163	14.4492
FORT BEND									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	4.6893	1.4315	0.7020	0.3426	0.0127	0.0060	1.5724	0.0103	8.7667
PRINCIPAL ARTERIALS	1.6027	0.4656	0.2270	0.1627	0.0037	0.0018	0.2506	0.0031	2.7172
OTHER ARTERIALS	2.1864	0.6432	0.3140	0.2071	0.0054	0.0024	0.3559	0.0041	3.7186
MAJOR COLLECTORS	1.1330	0.3362	0.1648	0.1051	0.0027	0.0013	0.1847	0.0022	1.9302
OTHER COLLECTORS	0.4630	0.1349	0.0656	0.0462	0.0011	0.0005	0.0748	0.0009	0.7870
LOCALS	1.3281	0.3884	0.1885	0.1300	0.0032	0.0016	0.2151	0.0023	2.2572
TOTAL	11.4025	3.3998	1.6619	0.9937	0.0289	0.0135	2.6537	0.0229	20.1769
WALLER									
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	1.5343	0.5804	0.2506	0.0373	0.0041	0.0024	1.7838	0.0030	4.1960
PRINCIPAL ARTERIALS	0.2298	0.0613	0.0612	0.0266	0.0005	0.0003	0.1516	0.0004	0.5317
OTHER ARTERIALS	0.0414	0.0108	0.0108	0.0051	0.0000	0.0000	0.0255	0.0000	0.0936
MAJOR COLLECTORS	0.4819	0.1272	0.1267	0.0596	0.0013	0.0005	0.2995	0.0008	1.0975
OTHER COLLECTORS	0.0633	0.0164	0.0162	0.0088	0.0001	0.0000	0.0389	0.0000	0.1437
LOCALS	0.1813	0.0466	0.0460	0.0253	0.0005	0.0001	0.1060	0.0003	0.4061
TOTAL	2.5320	0.8426	0.5115	0.1627	0.0065	0.0033	2.4054	0.0045	6.4685

Table 7, cont.
1999 9 % Rate-of-Progress SIP On-Road Mobile Source Current Control Emissions Inventory
Houston-Galveston Ozone Nonattainment Area
NOx, tons per ozone day

MONTGOMERY

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	6.3743	1.9508	0.9572	0.4587	0.0177	0.0082	2.1453	0.0139	11.9261
PRINCIPAL ARTERIALS	0.1898	0.0556	0.0269	0.0187	0.0005	0.0002	0.0300	0.0004	0.3220
OTHER ARTERIALS	1.9180	0.5688	0.2788	0.1772	0.0048	0.0023	0.3228	0.0037	3.2766
MAJOR COLLECTORS	2.2242	0.6590	0.3230	0.2067	0.0054	0.0025	0.3626	0.0043	3.7877
OTHER COLLECTORS	0.7791	0.2269	0.1108	0.0779	0.0019	0.0008	0.1242	0.0015	1.3231
LOCALS	1.4228	0.4136	0.2012	0.1418	0.0032	0.0016	0.2210	0.0026	2.4078
TOTAL	12.9082	3.8748	1.8980	1.0810	0.0335	0.0156	3.2059	0.0264	23.0434

LIBERTY

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	0.5418	0.2052	0.0885	0.0129	0.0016	0.0009	0.6373	0.0010	1.4892
PRINCIPAL ARTERIALS	0.8074	0.2124	0.2116	0.1006	0.0020	0.0008	0.5050	0.0014	1.8412
OTHER ARTERIALS	0.5284	0.1388	0.1381	0.0667	0.0013	0.0005	0.3280	0.0009	1.2026
MAJOR COLLECTORS	0.6019	0.1594	0.1589	0.0726	0.0015	0.0005	0.3760	0.0012	1.3720
OTHER COLLECTORS	0.2058	0.0538	0.0535	0.0268	0.0005	0.0002	0.1265	0.0004	0.4674
LOCALS	0.3755	0.0965	0.0955	0.0526	0.0009	0.0004	0.2200	0.0006	0.8420
TOTAL	3.0609	0.8661	0.7462	0.3322	0.0076	0.0032	2.1927	0.0055	7.2144

CHAMBERS

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	3.7802	1.4319	0.6184	0.0909	0.0103	0.0059	4.4452	0.0073	10.3901
PRINCIPAL ARTERIALS	0.0586	0.0151	0.0149	0.0083	0.0001	0.0000	0.0364	0.0000	0.1333
OTHER ARTERIALS	0.1498	0.0388	0.0386	0.0202	0.0004	0.0001	0.0934	0.0003	0.3417
MAJOR COLLECTORS	0.4245	0.1117	0.1112	0.0535	0.0011	0.0005	0.2626	0.0008	0.9658
OTHER COLLECTORS	0.0341	0.0088	0.0088	0.0047	0.0000	0.0000	0.0212	0.0000	0.0777
LOCALS	0.1495	0.0385	0.0380	0.0206	0.0003	0.0000	0.0866	0.0003	0.3338
TOTAL	4.5966	1.6447	0.8300	0.1982	0.0121	0.0065	4.9454	0.0087	12.2424

GALVESTON

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	2.4775	0.7604	0.3733	0.1759	0.0069	0.0031	0.8176	0.0054	4.6201
PRINCIPAL ARTERIALS	1.5417	0.4510	0.2199	0.1516	0.0038	0.0018	0.2494	0.0029	2.6221
OTHER ARTERIALS	2.0835	0.6079	0.2963	0.2057	0.0050	0.0024	0.3342	0.0038	3.5388
MAJOR COLLECTORS	0.1077	0.0320	0.0157	0.0097	0.0003	0.0000	0.0176	0.0002	0.1832
OTHER COLLECTORS	0.1472	0.0427	0.0207	0.0148	0.0004	0.0001	0.0233	0.0003	0.2496
LOCALS	0.7779	0.2287	0.1110	0.0741	0.0021	0.0009	0.1308	0.0013	1.3268
TOTAL	7.1355	2.1227	1.0370	0.6319	0.0184	0.0083	1.5729	0.0139	12.5405

Regional Totals

	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTALS
FREEWAYS	92.2522	27.5499	13.5316	6.6559	0.2464	0.1145	32.6003	0.1956	173.1463
PRINCIPAL ARTERIALS	21.5395	6.0958	3.1431	2.1067	0.0528	0.0241	3.9402	0.0385	36.9407
OTHER ARTERIALS	37.1598	10.5861	5.2941	3.4992	0.0925	0.0423	6.1531	0.0643	62.8913
MAJOR COLLECTORS	7.7277	2.2222	1.2931	0.7682	0.0191	0.0084	2.1403	0.0149	14.1938
OTHER COLLECTORS	3.0775	0.8765	0.4689	0.3109	0.0074	0.0031	0.8265	0.0056	5.5764
LOCALS	15.5430	4.4451	2.2612	1.4776	0.0405	0.0185	2.9436	0.0249	26.7544
TOTALS	177.2998	51.7755	25.9919	14.8185	0.4586	0.2109	48.6039	0.3438	319.5030

APPENDIX A:

CHANGES TO THE MOBILE SOURCE EMISSIONS INVENTORY DEVELOPMENT PROCESS FOR THE HOUSTON-GALVESTON OZONE NONATTAINMENT AREA

ADOPTED FOR THE JUNE 1996 AND SUBSEQUENT SIP REVISIONS

Methodology: Modifications to Previous Procedures

For the large part of the SuperSIP and VMT Offset SIP mobile source emissions inventory development work, the methodology employed by H-GAC followed procedures established when the original ROP and VMT Offset SIP inventories were conducted in 1993 and 1994. However, to account for advancements that have been made to travel demand modeling and emissions modeling procedures and for input data that is more recent and/or appropriate since that time, updates were made to the methodology. All changes were discussed and agreed upon in consultation with the TNRCC prior to incorporation into the methodologies.

The discussion of the methodology herein focuses only on changes that were made to the original procedures. Those aspects of the methodology that are not discussed can be assumed to be the same as those outlined in the original ROP SIP or VMT Offset SIP documentation.[7]

Demographic Forecasts

In late 1995, the Houston-Galveston Area Council (H-GAC) adopted a new set of demographic forecasts for the year 2020. For purposes of transportation planning, intermediate year forecasts in five-year increments from the Base Year (1990) to the forecast year (2020) were developed by interpolation. These intermediate estimates were adjusted to reflect 1995 Census population estimates, as well as Bureau of Economic Analysis and Texas Employment Commission data. Based on these estimates, forecasts of households and employment were produced by interpolation for 1996, 1999 and 2007. These forecasts serve as the basic input data, along with transportation system descriptions (e.g., networks), to the travel demand analysis process.

The forecasting process used to develop the new forecasts was fundamentally different from that used in the original 1996, 1999 and 2007 On-Road Mobile Source Emissions Inventories process. Forecast preparation involved a two-step process: development of regional forecasts (which serve as "control" totals) and the subsequent allocation of these forecasts to various geographical subareas, ultimately leading to traffic analysis zone (TAZ)-level forecasts. Regional forecasts of population, households, and employment were prepared using econometric and cohort component techniques. These techniques tie the regional forecast to statewide and national economic trends and also integrate employment opportunities with the available labor force. These forecasts then become the "control" totals for subsequent, subarea allocations.

The first subarea allocation involved allocation of the regional forecasts to 199 subareas called Regional Analysis Zones (RAZs). Using an established allocation modeling process, subareas compete with each other for development based on land availability, land use development patterns, accessibility, market forces and historical development trends. This approach incorporates the interaction of land use and transportation activities. The RAZ-level forecasts were subsequently allocated to census tracts and then to TAZs using a procedure which utilizes estimates of vacant, usable and developed land at both the census tract and TAZ level.

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[7] See *1996 Control Strategy Projected On-Road Mobile Source Emissions Inventory for the Houston-Galveston Ozone Nonattainment Area*, and *VMT Offset SIP Emissions Estimation Procedure for the Houston-Galveston Area Council*, produced by H-GAC and submitted to the TNRCC in September 1993 and July 1994, respectively.

Table 4 below presents the 1990 estimates (which were the basis for the forecast) as well as forecasted 1996, 1999 and 2007 population, households and employment for the eight-county non-attainment area.

TABLE 5
REGIONAL HOUSEHOLDS AND EMPLOYMENT ESTIMATES AND FORECASTS
1990, 1996, 1999 and 2007

	YEAR			
	1990	1996	1999	2007
Households	1,338,775	1,564,229	1,666,837	1,908,407
Employment	1,809,856	2,047,945	2,140,746	2,480,490

Source: H-GAC, March, 1997

Travel Model Changes

As part of a 1990 travel model re-validation, which was completed in 1995, some changes to the Houston-Galveston Regional Travel Models have been made since the development of the original ROP SIP and VMT Offset SIP On-Road Mobile Source Emission Inventories.

- Trip Generation

The first change involves the trip generation portion of the regional travel models. In the 1990 demographic data, enrollment for junior colleges and community colleges was added. Since many of the students and staff are part-time at community colleges and some junior colleges, separate trip attraction rates for four-year colleges and community/junior colleges were developed and applied in the 1990 model re-validation. This was carried forward in the application of the models for 1996, 1999 and 2007 travel demand analysis for the emissions inventories.

Another change made to the trip generation models as part of the 1990 re-validation involves the incorporation of non-resident trips into the trip generation models. Historically, the regional travel models have not accounted well for the non-resident (tourist) oriented travel in the coastal portions of the region. Based on historic hotel/motel occupancy rates and the estimated supply of non-resident housing (hotels/motels and seasonal), estimates of non-resident non-homed based trips are made. This change was carried forward in the application of the models for 1996, 1999 and 2007 travel demand analysis for the emissions inventories.

The trip generation models applied in the travel demand analysis for the original 1996, 1999 and 2007 emissions inventories utilized five distinct household income ranges. In order to utilize the forecasts of households produced by the new demographic forecasting procedure, the models were modified to work with household income quintiles.

Lastly, revised external-local and external-through vehicle trips were developed through interpolation using 1990 traffic counts and TxDOT's projected 2010 daily traffic forecasts at the external stations.

- Trip Distribution

The Houston-Galveston Regional Travel Models have historically utilized the original version of TxDOT's Atomistic trip distribution model (referred to as the "ATOM" model) for the distribution of all internal trips in the Houston-Galveston region. As part of 1990 model re-validation efforts, a newer version of the Atomistic model (referred to as "ATOM2") was applied. This version of the Atomistic model differs from the original Atomistic model in that ATOM2 allows for the input of F-factors (friction factors) and holds the factors constant during the iterative distribution process. In the use of F-factors, which are relative measures of zones' "attractiveness" to one another, ATOM2 is very similar to the traditional gravity model. The F-factors used in the 1990 re-validation and in the 1996, 1999 and 2007 applications were developed and calibrated using 1985 data and validated to the year 1990. This change only applies to the distribution of internal trips. External-local trip distribution has always been performed using the ATOM2 model.

Due primarily to the change in the forecasted households and employment, the number of trips by trip purpose, vehicle miles of travel (VMT) and speed have been updated from the original emissions inventories estimates . Tables 6 and 7 below present the new trip summary statistics.

TABLE 6
1990, 1996, 1999 and 2007 TRIP ESTIMATES

Trip Purpose	1990 Trips	1996 Trips	1999 Trips	2007 Trips
Home-base work[A]	2,199,387	2,423,975	2,697,743	3,065,613
Home-based non-work[A]	6,119,491	6,685,400	7,346,395	8,261,710
Non-home based[A]	3,875,832	4,258,536	4,729,783	5,366,771
Truck/taxi[B]	573,565	621,886	767,620	893,958
External-local[B]	184,890	218,527	261,718	338,280
External-through[B]	5,877	6,922	23,613	30,713

[A] - person trips
[B] - vehicle trips
Source: Houston-Galveston Area Council, March, 1997

TABLE 7
SUMMARY STATISTICS - INTERNAL TRIP ESTIMATES
FOR THE EIGHT COUNTY NONATTAINMENT AREA

Year	Person Trips	Percent Transit[A]	No. of HOV Carpools	Carpool Avg. Auto Occupancy	Non-Carpool Avg. Auto Occupancy	Vehicle Trips
1990	12,194,710	3.91	18,206	2.18	1.27	9,195,439
1996	13,367,911	4.14	24,628	2.17	1.25	10,096,646
1999	14,773,921	4.55	43,195	2.17	1.13	12,367,723
2007	16,694,094	4.68	65,471	2.17	1.12	14,069,084

[A] - includes both public transit and school bus trips
Source: Houston-Galveston Area Council, March, 1997

Post-Travel Model Changes

- HPMS Adjustment

In the original ROP SIP and VMT Offset SIP on-road mobile source emissions inventories, the HPMS consistency adjustment was made at the 24-hour total regional emissions level. This continued a HPMS adjustment practice begun with the original 1990 Base Year On-Road Mobile Source Emissions Inventory. It has been recognized for some time, in addition to being theoretically weak, that this method of adjustment is not consistent with the intent of the EPA-mandated HPMS adjustment or HPMS adjustment practice of the state's other non-attainment regions.

As part the development of estimates for SIP revisions for the Houston-Galveston Area, H-GAC performed a comparison of regional travel model VMT and HPMS VMT for the year 1995 in order to update HPMS adjustment factors. The regional travel model VMT was developed using *1995* demographic forecasts developed by H-GAC along with a 1995 roadway network and the Houston-Galveston Regional Travel Models. With the development of the revised emissions estimates for the Super SIP, H-GAC began a practice of developing and applying an HPMS adjustment factor by road type (non-local and local) at the regional level. Table 8 below presents updated HPMS non-local and local adjustment factors.

Table 8
HPMS ADJUSTMENT FACTORS
DEVELOPED FROM 1995 VMT ESTIMATES

Road Type Group	HPMS Adjustment Factor
Non-local	1.0062
Local	1.0777

Source: Houston-Galveston Area Council, March 1997.

A more detailed explanation is provided in the technical memorandum in Appendix B.

- Seasonal Adjustment

In an effort to use the most current data possible, revised VMT seasonal adjustment factors were used in the development of new *1996, 1999 and 2007 on-road mobile source emissions inventories.* As was done in the original inventory development, the VMT seasonal adjustment factor is applied to the link-level VMT prior to post-assignment speed estimation. The revised seasonal adjustment factors are based on 1993 data from TxDOT permanent automatic traffic recorders (ATRs). Given the limited number of ATRs (11 ATR locations total, 7 within Harris County) and the concentration of nearly all ATRs on relatively high volume facilities (greater than 100,000 AADT), a single adjustment factor was estimated for the entire region.[8] The one exception is Galveston Island, which experiences very large seasonal changes in traffic volume. To account for the difference at Galveston, a separate, and much

[8] 1993 data from the 11 ATR locations was obtained from the *Permanent Automatic Traffic Recorder Year-End Report,* Texas Department of Transportation, Transportation Planning and Programming Division.

higher, VMT adjustment factor was estimated from the TxDOT ATR location on IH-45 at the Galveston Causeway. Travel model estimates of VMT are then multiplied by the corresponding adjustment factors (shown in Table 9).

The travel model estimates of VMT attributable to HOV carpools are also seasonally adjusted to summer levels based on an analysis of count data from all HOV facilities in Houston. To account for a general decline in work-related travel, which accounts for virtually all of the HOV travel in the region, HOV VMT is multiplied by a factor of 0.98.

TABLE 9
SEASONAL ADJUSTMENT FACTORS

	ATR Daily Vehicle Counts (12 months)	ATR Daily Vehicle Counts (Ozone Season)	Adjustment Factor
Regional Average[A] (10 locations)	837,629	856,100	1.02
Galveston Island (1 location)	59,170	62,735	1.06

Source: Houston-Galveston Area Council, June 1996

Development of Emission Factors

The changes to the state inspections/maintenance program were among several addressed in the development of emission factors for the revised ROP SIPs. The geographic scenario basis was modified in the MOBILE5H inputs, and a more recent registration distribution was used. An updated POLFAC program was used to produce emission rates for different speeds, and a new program was used to obtain the commute-adjusted rates.

- MOBILE5H Inputs

  I/M Settings - All scenarios involving the modeling of the inspections/maintenance program included changes in the MOBILE parameters to reflect the anticipated effects of the "Motorists' Choice" program approved by the governor's office in November 1995, and to account for the capability of MOBILE5H to take into account credits for technician training in the program. Changes include model year coverage, test type, inspection frequency[9] and anti-tampering tests performed; MOBILE5H One-Time data inputs are indicated in the Table 10. In addition, the Technical Training flag was set to "2" to take credit for the training aspect of the program.

[9] It should be noted that the Motorists' Choice program will incorporate both annual and biennial two-speed idle testing. However, for the purposes of modeling I/M programs for the SIP, and pursuant to the NHS Designation Act, the credit taken for decentralized programs is the same as that for centralized. Thus, only one 2500/idle option was listed.

Table 10
I/M Program One-Time Data Input Record

Description	Annual 2500/Idle
Program Start Year: (Harris County only)	1996
Stringency Level (%)	20%
First Model Year / Last Model Year	Last 24 yrs.
Waiver Rate for Pre-1981 Model Year Vehicles (%)	3%
Waiver Rate for 1981 Model Year Vehicles and Later (%)	3%
Compliance Rate (%)	96%
Program Type (1=test only)	1
Inspection Frequency (1=annual, 2=biennial)	1
Vehicle Type Subject to Inspection: LDGV,LDGT1,LDGT2,HDGV (1=not subject to, 2=subject to)	2,2,2,2
Test Type (1=idle, 2=2500/idle, 3=loaded/idle, 4=transient, 5=ASM)	2
Cutpoint Flag (1=default, 2=user-specified)	2
Alternate I/M Credit Flag: Tech I-II, Tech IV vehicles (1=default, 2=user-specified)	1,1
User-Supplied Cutpoint For HC, CO, NOx	220/1.2/999
Functional Pressure Test Required?	Yes
Functional Purge Test Required?	No
ATP Test Required? **Motorist's Choice:** For all model years: EGR system, evap. emission contrl syst., gas cap, PCV syst., thermostatic air cleaner, air injection syst. For model yrs >1981: Above & catalytic converter.	Yes

Registration Distribution - 1993 Registration data was used, instead of 1990 data, on the assumption that the more recent data was more indicative of the current distribution.

Geographical scenario grouping - Three separate geographic "areas" were selected to simplify the emission factor modeling for the eight-county region for both CS and CC scenarios, in contrast with the four selected for the original ROP SIP CS scenario submittal and the three for the CC scenario: Harris County, the only county whose registered vehicles are required to undergo I/M testing; "urban" counties, consisting of Brazoria, Fort Bend, Montgomery, and Galveston; and "rural" counties, consisting of Chambers, Liberty and Waller. The division of the seven counties outside of Harris into two categories was made after an informal analysis of 1993

data[10] indicated that the vehicle-miles-of-travel (VMT) mix was distinctly different for the "urban" and "rural" areas.

- The MOBILE5H Model

As mentioned, the MOBILE5H version of EPA's mobile source emission factor model was used to take into account credits accruable to technician training that is planned as part of the Motorists' choice program. This hybrid version of the MOBILE model was otherwise the same as MOBILE5a.

- The POLFAC5B Model

H-GAC used the FORTRAN model developed by the Texas Transportation Institute (TTI) to run the MOBILE model at all speeds from three to 65 miles per hour. The 5B version of the TTI program also produces output for the various VOC emissions components, including exhaust and running loss by speed and vehicle type, and resting loss, crank case, hot soak and diurnals by vehicle type.

- Corrections to attribute emissions characteristics to those vehicles actually driven in areas of evaluation

The current analysis assigns emissions characteristics more closely in geographic terms to those vehicles on the region's roads than in the past. Conventionally, H-GAC has developed mobile source emissions inventories based on the emission rates of vehicles by county of registration and on the miles of travel of vehicles by location of activity. The TNRCC and H-GAC have previously acknowledged the geographical inaccuracy of this methodology, as the emission factors and the VMT are related to different sets of vehicles. However, owing to the nature of the originally planned inspections/maintenance (I/M) program, the effective emission factors of vehicles on the road were assumed to correlate with the emission factors of the registered vehicles in a county, eliminating the discrepancy.[11] The currently adopted I/M program applies only to Harris County, on the other hand, making prior assumptions less plausible. In the present analysis, H-GAC has thus sought to develop a procedure by which the emission factors used in the emissions inventory compilation process reflected travel activity more closely.

The emission factor analysis relied on an estimation of vehicle activity by origin, based on vehicle trips. The vehicle trips are compiled prior to traffic assignment by trip purpose into "production-attraction" trip tables, each cell of which contains the number of trips by either productions (i.e., the home or base of vehicle activity) or attractions (i.e., the destination of vehicle activity). To produce a county origin/destination-based estimate of trips (and, consequently, VMT), it was assumed that the origin of vehicle trip productions for home-based trips correlates closely with the registration county of the vehicle. Following the production of VMT estimates, a matrix containing the percent of VMT attributable to each of the three county subgroups was developed. This matrix is referred to as the commute/non-commute percentage matrix.

[10] The data was collected for the Coastal Oxidant Assessment for Southeast Texas (COAST) study in 1993.

[11] Because the originally-mandated state inspections/maintenance program was to cover most of the Houston-Galveston region's vehicles, the emission rates of vehicles would have been similar for most areas in the region. The emission rates developed for vehicles by county of registration were thus assumed to correspond to the rates of the vehicles traveling in an area at any one time, to simplify the modeling procedure.

The first step in the development of the commute/non-commute matrix involved the assignment of the 1996 home-based production-attraction trip tables to the 1996 highway networks. Using the resulting VMT information, an initial commute/non-commute matrix of home-based VMT was developed. Since the initial matrix did not account for the county group of origin of non-home-base (NHB) trip VMT (the single largest individual trip purpose in terms of the number of trips), the next step was to assign the 1996 NHB trip table to the 1996 network[12]. The resulting VMT was then separated into the three county groups based on the distribution of home-based trips by county group. The next step in the process was to total the home-based VMT and non-home-based VMT together by county group. The last step involved the percentage breakdown of the "destination" VMT total by county group of origin.

The resulting commute/non-commute matrix is shown in Table 11. The table indicates, for example, that vehicles coming from Harris County produce 9.1 percent of the VMT occurring in the Urban Counties.

TABLE 11
COMMUTE/NON-COMMUTE VMT SHARE
(by county group)

		COUNTY GROUP TO		
		Harris	Urban[A]	Rural[B]
COUNTY GROUP FROM	Harris	0.83074	0.09107	0.08422
	Urban	0.15052	0.89689	0.07325
	Rural	0.01875	0.01204	0.84253
	Total	1.00000	1.00000	1.00000

[A] - Brazoria, Fort Bend, Montgomery, Galveston
[B] - Chambers, Liberty, Waller
Source: Houston-Galveston Area Council, June 1996

The fractions were then used to develop "commute" weighted, or effective, emission factors that can be applied to link-level VMT in each of the eight counties for which emissions analysis is conducted. The effective factors were obtained by the following equation:

$$ef_{i,\text{eff}} = \sum_{j} \beta_{i,j} \cdot ef_{j} \qquad (1),$$

where ef represents emission factor, i the county where the travel activity occurs, j the county where the travel originates, and β the commute/non-commute fraction of the VMT in county i from county j.

[12]Determining the county of vehicle origin of a non-home-based (NHB) trip is problematic given, the fact that these trips are dealt with in an origin-destination manner and not in a production-attraction manner (as neither end of the trip is the home end). It was decided that the distribution of home-based trips (not VMT) by county group could be used to segregated NHB VMT. The logic for this rationale rests in the assumption that many, if not most, non-home-based trips are "chained" to home-based trips and hence the home-based trip production county is a reasonable indicator for county of vehicle origin of a non-home based trip.

These factors were obtained by running the RATEADJV program developed by TTI.[13] Along with the VMT commute/non-commute percentages, the registration vehicle emission factor outputs from POLFAC5B were used as inputs.

Emissions Modeling

H-GAC used the FORTRAN program IMPSUMA developed by TTI to estimate highway emissions by time-of-day, high-occupancy vehicle (HOV) emissions for the a.m. and p.m. peak periods, and intrazonal travel over a 24-hour period. IMPSUMA accomplishes the same objectives as IMPSUM, with one significant improvement[14]. With the appropriate temperature distribution and VMT total inputs, the program allocates the diurnal emissions by time-of-day and by facility type and vehicle type, corresponding to the format of the existing IMPSUM output. This capability also streamlines the emissions post-modeling process, as the incorporation of diurnals eliminates the need to undertake a step to evaluate diurnal emissions separately.

Post-Modeling Adjustments

The spreadsheet calculations were very similar to those used previously to total the emissions results from the IMPSUMA time-of-day runs, the HOV assignment runs, the intrazonal assignment runs, bus emissions (Harris only), and non-recurring congestion (Harris only). The procedures used to obtain November 15 emissions were modifications from previously used procedures.

- CS and CC Inventories

  Harris County. There were two modifications to the procedure used to obtain Harris County emissions, specifically. Estimates of transit bus emissions, based on 1993 VMT estimates from the Harris County Metropolitan Transit Authority, were added to Harris County estimates of VMT. Updated factors to account for nonrecurring congestion were developed, based on the updated 1996, 1999 and 2007 estimates of VMT and speeds for Harris County freeways and new assumptions about the free-flow speeds.[15]

  November 15 Date of Evaluation. All final estimates of county emissions were obtained, first on the basis of a July 1 MOBILE5 evaluation date, and then using a November 15 evaluation date based on a procedure modified from that outlined in the *November 15, 1996 Adjustment and Benefits of Control Strategies for On-Road Mobile Source Emissions Inventories for the Houston-Galveston Ozone Nonattainment Area* (September 1993). Average 24-hour speeds for each facility type were first determined using a VMT-weighted average of the time-of-day speeds

[13] See draft copy of *Texas Mobile Source Emissions Software: Version 2.0 User's Manual*, written by Charles Bell, Jimmie Benson and George Dresser, TTI.

[14] *ibid.*

[15] In the past, H-GAC has used 58.5 mph as the assumed freeway free-flow speed, based on a review of TxDOT travel behavior data when the nonrecurring congestion methodology was initially established. As a likely result of the changes in the speed limits on the freeways outside of Beltway 8 and assumptions about the corresponding changes in travel behavior, H-GAC found that the estimated average speeds on Harris freeways increased and in some cases exceeded existing free-flow speed estimates. Using professional judgment, staff estimated free-flow estimates to be at a minimum of 61.5 mph, 3 mph higher than that used previously.

for the Harris, Urban, and Rural areas. Emission factors were then developed for a July 1 date of evaluation for each vehicle type and facility type for both 1996 and 1997. Then, using Equation 1 listed in the *November 15* document, and by substituting the appropriate emissions factors for the emission total indicated in the equation, staff obtained the adjustment factors for each vehicle and facility type corresponding to each particular county group.[16] Staff then multiplied the July 1 emission totals for each county, facility type and vehicle type by the corresponding adjustment factor to arrive at a final November 15 total.

[16] The justification for using emission factors instead of emissions totals was that, because H-GAC does not develop travel networks or assignments for 1997, the same 1996 VMT estimates would have been used in the determination of the emissions estimates for both 1996 and 1997. Since the VMT basis would have been identical, it would not have been additionally meaningful to compare the emissions totals.

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TECHNICAL MEMORANDUM

To: Teresa Hardin Nguyen, TNRCC
Mark Matteson, H-GAC
From: Andy Mullins, H-GAC
Date: March 25, 1997
Re: **Development of Updated HPMS Adjustment Factors**

Summary

As part the development of a revised VMT Offset SIP for the Houston-Galveston Area, H-GAC has performed a comparison of regional travel model VMT and HPMS VMT for the year 1995 in order to update HPMS adjustment factors. The regional travel model VMT was developed using 1995 demographic forecasts developed by H-GAC along with a 1995 roadway network and the Houston-Galveston Regional Travel Models. With the development of the revised 1996 and 1999 emissions estimates for the Super SIP, H-GAC began a practice of developing and applying an HPMS adjustment factor by road type (non-local and local) at the regional level. Table 1 below presents updated HPMS non-local and local adjustment factors.

TABLE I
HPMS ADJUSTMENT FACTORS
DEVELOPED FROM 1995 VMT ESTIMATES

Road Type Group	HPMS Adjustment Factor
Non-local	1.0062
Local	1.0777

Adjustment factor development

Soon after the completion of the Super SIP emissions estimates in 1996, H-GAC staff began a review of the process for developing the HPMS local VMT adjustment factor. The first step was to review with TxDOT staff the process used to estimate the local VMT component of HPMS. During this review, it became clear that the local HPMS VMT estimate was not a traffic count-based estimate. HPMS local street mileage is estimated by county from inventory data. H-GAC staff independently verified HPMS mileage estimates for local streets through application of its Geographic Information System. The vehicle travel on local streets contained in HPMS, however, was developed from typical "lookup" values based on the total county population. As a consequence of its review, H-GAC has developed an independent, count-based estimate of local VMT using TxDOT's 1990 "saturation" counts. These count-based estimates vary significantly from those contained in HPMS.

Due to the amount of data involved, H-GAC efforts were focused on Harris County, which represents a large majority of estimated local street VMT. TxDOT's 1990 saturation counts included approximately 1,100 locations on non-functionally classified (i.e., local) streets. These locations were subdivided into urban and rural locations based on 1990 Census definitions to allow for separate estimates of urban and rural average local street volumes. Based on TxDOT's 1990 saturation counts, H-GAC calculated [illegible]

APPENDIX B:

TECHNICAL MEMORANDUM CONCERNING REVISIONS TO THE HPMS ADJUSTMENT FACTOR FOR THE HOUSTON-GALVESTON OZONE NONATTAINMENT AREA

TABLE 2

DEVELOPMENT OF 1995 HPMS VMT ADJUSTMENT FACTORS

HPMS non-local ozone season VMT	=	HPMS AADT x AWT adjustment factor x ozone season adjustment factor
	=	88,836,011 x 1.064 x 1.009
	=	95,372,209
H-GAC modeled non-local ozone season VMT	=	Model network AWT x ozone season adjustment factor
	=	93,941,960 x 1.009
	=	94,787,438
HPMS non-local adjustment factor	=	HPMS non-local ozone season VMT / H-GAC modeled non-local ozone season VMT
	=	95,372,209 / 94,787,438
	=	1.0062
HPMS local ozone season VMT	=	HPMS local VMT - Harris County local VMT + ((Harris County urban local mileage x 790) + (Harris County rural local mileage x 469))
	=	14,009,484 - 11,069,283 + ((10,281.724 x 790) + (557.536 x 469))
	=	11,324,247
H-GAC modeled local ozone season VMT	=	Model centroid connector VMT + Model intrazonal VMT
	=	9,929,218 + 578,713
	=	10,507,931
HPMS local adjustment factor	=	HPMS local ozone season VMT / H-GAC modeled local ozone season VMT
	=	11,324,247 / 10,507,931
	=	1.0777

average volume on urban local streets in Harris County was 790 vehicles per day, while the average volume on rural local streets in Harris County was 469 vehicle per day. Using the HPMS estimates of urban and rural local mileage for 1995 and the averages cited above, a count-based estimate of 1995 Harris County local VMT was developed and substituted for the HPMS estimate of Harris County local VMT.

Another step in the review of the HPMS local VMT adjustment factor was to reexamine the AWT and ozone season adjustment of local VMT. H-GAC has concluded that it is inappropriate to apply adjustment factors to local street VMT estimates from HPMS for either seasonal variations or differences between average weekday versus average daily VMT. Since the 1990 TxDOT "saturation" counts were weekday counts, no adjustment factor to convert the estimated Harris County local VMT to weekday VMT is needed. Furthermore, no data exists to support either a weekday adjustment factor or a seasonal adjustment factor for local street travel.

Based on its revised estimate of local street VMT in Harris County, H-GAC developed a comparison of 1995 HPMS and 1995 modeled VMT. The results of this comparison, which is summarized in Table 1 above, show that H-GAC modeled VMT is in relatively close agreement with HPMS estimated VMT.

The non-local VMT comparison was performed using updated AWT and seasonal adjustment factors from the eight TxDOT permanent traffic recorders located in the Houston-Galveston region. The local street comparison was made using HPMS local street VMT with H-GAC's Harris County count-based estimates. The attached Table 2 details the development of the comparison.

Application of adjustment factors

H-GAC's analysis demonstrates that estimates of local street VMT from actual counts is preferable to a "lookup" table based estimate. H-GAC continues to work with TxDOT to determine how to establish a better estimate of local street VMT for the entire Houston-Galveston region.